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SYNOPSIS

Objective. Mothers' affective responses to infant laughing are essential in parent-child interaction. This experimental study examined whether instructing mothers to employ emotion regulation strategies can change their self-reported, physiological, and facial expressive responses to infant laughing. ***Design.*** Using a within-subjects design, mothers (N = 100, age M = 30.87 years) were exposed to infant laughing sounds while receiving enhancement, suppression, and no emotion regulation instructions. Positive affect, perception of laughing, intended sensitive and insensitive caregiving responses, skin conductance level, and facial expressions in response to infant laughing were measured. ***Results.*** Enhancement resulted in increased positive affect, a more positive perception of the laugh, more intended sensitive caregiving responses, and, compared to suppression, fewer intended insensitive caregiving responses. Moreover, enhancement resulted in lower sad and, compared to suppression, higher happy facial expressivity. In contrast, suppression resulted in a less positive perception. Enhancement did not affect skin conductance level. ***Conclusions.*** Enhancement can have beneficial effects on mothers' self-reported and facial expressive responses to infant laughing in an experimental setting. Enhancement instructions may be used to increase mothers' positive feelings in response to infant laughing and to promote sensitive caregiving behaviors and positive facial expressions, which may benefit affective mother-child interchanges.

INTRODUCTION

Infant laughing is a communication signal that is important to the parent-child relationship. It evokes feelings of love and happiness in parents (Groh & Roisman, 2009). Infant laughing activates individuals' brain regions associated with the reward system (Kringelbach, 2005; Riem et al., 2012). However, not all parents perceive infant laughter as rewarding and respond sensitively to infant signals, affecting the parent-child relationship (Beebe et al., 2016). Therefore, it is important to examine effective strategies that may stimulate parents to respond sensitively to their child's laughing. In the current study, we examined whether instructing mothers to employ specific emotion regulation strategies can change their self-reported, physiological, and facial expressive responses to infant laughing.

Mothers typically respond to infant laughing and smiling with affective behaviors, which, in turn, elicit infant laughing and smiling responses (Mendes, Seidl-de-Moura, & de Oliveira Siqueira, 2009; Nwokah, Hsu, Dobrowolska, & Fogel, 1994). Those reciprocal interactions are important for children because they learn to trust their parents to attend their needs, and they feel supported by their parents to express their feelings (Juffer, Bakermans-Kranenburg, & van IJzendoorn, 2017). Mothers' emotional facial expressions are essential in this affective interchange (Beebe et al., 2016; Mendes et al., 2009; Mireault et al., 2015). Mothers' happy and sad facial expressions are especially relevant, as these facial expressions can be distinguished and imitated by newborns (Field, Woodson, Greenberg, & Cohen, 1982). Infant laughing sounds also evoke physiological arousal, such as skin conductance level reactivity, in mothers and non-parents (Emery, McElwain, Groh, Haydon, & Roisman, 2014; Groh & Roisman, 2009). This increased level of arousal may stimulate caregiving responses to the laughing infant. Therefore, it is important to examine parental responses to infant laughing.

Individuals may engage in emotion regulation strategies when responding to infant laughing (Dix, 1991). By employing regulatory strategies, people can modify their experiences of emotions (Gross, 2015). The use of emotion regulation strategies can increase or decrease emotion experience as well as physiological and facial responses to positive stimuli (e.g., Giuliani, McRae, & Gross, 2008; Gross & Levenson, 1997; Quoidbach, Mikolajczak, & Gross, 2015). Moreover, instructing mothers to use a specific emotion regulation strategy can change their self-reported, neural, physiological, and facial expressive emotional responses to infant crying (Firk, Dahmen, Lehmann, Herpertz-Dahlmann, & Konrad, 2018; Riem & Karreman, 2019). Specific emotion regulation strategies may be used by mothers to increase positive feelings during infant laughing and to promote sensitive parental responses. However, to the best of our knowledge, the effects of emotion regulation strategies have not been examined in mothers exposed to infant laughing.

Enhancement, referring to the up-regulation or accentuation of feelings (Webb, Miles, & Sheeran, 2012), is an emotion regulation strategy that may be particularly adaptive for mothers in the context of infant laughing. In contrast, suppression of emotion experience, referring to the down-regulation of feelings (Webb et al., 2012), is likely a maladaptive strategy, because mothers who suppress their emotions would not fully experience the rewarding effects of infant laughing. There is experimental evidence that enhancement intensifies positive emotion experience (Karreman, Laceulle, Hanser, & Vingerhoets, 2017; Moutsiana et al., 2014), whereas suppression diminishes emotional experience (Ohira et al., 2006; although not confirmed by other studies: Hofmann, Rauch, & Gawronski, 2007; Karreman et al., 2017). Most previous experimental research focused on enhancement and suppression of emotion *expression* (e.g., showing as much as you can vs. not showing visible signs of your feelings) instead of emotion *experience* (e.g., giving in to vs. not paying attention to your feelings) (e.g., Bonanno, Papa, Lalande, Westphal, & Coifman, 2004; Gyurak, Goodkind, Kramer, Miller, & Levenson, 2012). In mothers exposed to infant laughing, enhancement of positive emotion experience may, however, be more effective. Enhancement of positive emotion expression may feel inauthentic, which may impede actual responsiveness (Le & Impett, 2016), so it is better to focus on enhancing the emotional experience rather than outward expression.

Besides changing feelings, enhancement and suppression of emotion experience may also change mothers' caregiving, facial expressive, and physiological responses to infant laughing. Enhancement may promote more flexible and sensitive parenting behaviors in young mothers, as, according to the broaden-and-build theory, positive emotions broaden one's array of thoughts and actions (Fredrickson, 2001). By enhancing positive emotion experience, parents may more accurately perceive and interpret the infant's laughing signal and react promptly and adequately to this signal, all key components of parental sensitivity (Ainsworth, Blehar, Waters, & Wall, 1978). Positive facial expressions are part of adequate responding to the infant's laughing signal because of their essential role in affective parent-child interaction (Beebe et al., 2016; Mendes et al., 2009; Mireault et al., 2015). Thus, enhancement, as opposed to suppression, of positive feelings may promote sensitive caregiving behaviors and positive facial expressivity when exposed to infant laughing.

Enhancement and suppression may also affect mothers' physiological arousal. Specifically, these strategies may both heighten physiological arousal, because they require effort, as they are response modulation strategies that are applied after emotions have been generated (Gross, 2015). Previous research found support for increased skin conductance level as a sign of emotional suppression (Roisman, Tsai, & Chiang, 2004). Furthermore, suppression results in higher skin conductance level reactivity to infant crying and a more negative perception of the cry compared to the strategy reappraisal, and increased sad facial expressions compared to a control condition in which mothers were exposed to infant crying but received no emotion regulation instructions (Riem & Karreman, 2019).

The current study aimed to obtain more knowledge on the effects of emotion regulation strategies on mothers' responses to infant laughing. Specifically, this study examined whether instructing mothers to enhance and suppress their emotional experience can change their self-reported, physiological, and facial expressive responses to infant laughing. An experimental within-subjects design was used, in which mothers were exposed three times to a standard infant laughing sound. Mothers were instructed to listen to the sound (control condition), to employ enhancement (enhancement condition), and to employ suppression of emotion experience (suppression condition).

First, we examined whether mothers' positive affect when exposed to the laugh sound can be manipulated by giving mothers instructions to employ enhancement or suppression, both strategies aimed at changing feelings. Positive affect can be manipulated through enhancement and suppression (Karreman et al., 2017; Moutsiana et al., 2014; Ohira et al., 2006), so we expected that mothers' positive affect can be manipulated: The level of positive affect was expected to be highest in the enhancement condition and lowest in the suppression condition. Second, we examined the effects of enhancement and suppression on mothers' self-reported perception of the laugh sound, self-reported intended sensitive and insensitive caregiving responses, skin conductance level, and happy and sad facial expressions in response to infant laughing. In accordance with theory and prior research (e.g., Fredrickson, 2001; Groh & Roisman, 2009; Roisman et al., 2004), we expected enhancement to increase the pleasurable, rewarding experiences of infant laughing, heighten physiological arousal, and motivate sensitive responses. Therefore, we expected that enhancement would result in a more positive perception of the laugh sound, more sensitive and less insensitive intended caregiving responses, higher happy and lower sad facial expressivity compared to the control and suppression conditions, and higher skin conductance level reactivity compared to the control condition. In contrast, suppression was expected to diminish the pleasurable, rewarding experiences of infant laughing. Mothers who suppress their emotional experience may, therefore, be less motivated to approach their child in a sensitive manner (Dix, 1991; Roisman et al., 2004). Additionally, suppression was expected to heighten physiological arousal because it requires effort (Gross, 2015). Therefore, we hypothesized that suppression would result in a less positive perception of the laugh sound, less sensitive and more insensitive intended caregiving responses, lower happy and higher sad facial expressivity compared to the control and enhancement conditions, and higher skin conductance level reactivity compared to the control condition.

METHOD

Participants

The total sample consisted of 101 mothers with a child younger than 3 years of age. Due to procedural errors in administering the Laugh Paradigm, data were missing for one mother, resulting in a sample of 100 mothers for this study. Age of the children ranged from 1 to 36 months (M = 13.70 months, SD = 9.04). The age of the mothers ranged from 21 to 41 years (M = 30.87 years, SD = 4.25). Of the mothers, 3.2 %were single, 53.7% were married, 9.5% were in a civil partnership, 32.6% were living with a partner, and 1.1% was a widow (demographic data of five participants were missing). The majority of participants were born in the Netherlands (86.3%) and had a paid job (84.2%). Concerning education, 4.2% of the mothers had completed elementary school, 34.7% had completed intermediate/higher secondary education, 35.8% had completed higher secondary education, and 25.3% had a bachelor's or master's degree. Furthermore, 46.3% of the mothers had one child, 40% had two children, 10.5% had three children, and 3.2% had four children. Exclusion criteria were hearing problems because of the need to accurately hear the infant laughing sound, and insufficient mastery of the Dutch language because of the need to understand all instructions and questionnaires. A priori power analysis using G*Power 3.1 for repeated measures (within-subjects factors) showed that a sample size of 73 is sufficient to detect small to medium effects (f = .15, α = .05, power .80, 3 measurements). All participants gave informed consent. Permission for this study was obtained from the local ethics committee (protocol number: EC-2016.38).

Procedures

Mothers were recruited by contacting daycare centers, which were asked to distribute recruitment flyers and information letters about the study, and by asking among acquaintances of the students who helped to collect the data (directly and indirectly using Facebook and further spread through word of mouth). Trained undergraduate and graduate students visited mothers who signed consents at home as part of a more extensive study on the perception of infant signals. Mothers completed an online questionnaire (not used in this study, except for demographic details) 1 or 2 weeks before the visit took place. During the home visit, mothers were seated behind a laptop at a high table in the living room or kitchen. When children were at home, the experimenter looked after them, so that mothers were distracted as little as possible during the assessment. The home visit started with fitting electrodes of an ambulatory monitoring system to the middle and index finger of mothers' non-dominant hand for the measurement of skin conductance. Mothers' fingers were cleaned with water, and two electrodes were filled with isotonic electrode gel before fitting them to the fingers. Next, a cognitive assessment and Cry Paradigm were administered for the purpose of other studies (e.g., Karreman & Riem, 2019; Riem & Karreman, 2019), followed by the Laugh Paradigm, which was the focus of the current study. During the Laugh Paradigm, mothers wore headphones to listen to audio fragments. An external frontfacing webcam was attached to the top of the laptop screen to record the mother's face.

Measures

Laugh Paradigm

An adapted version of a previously used laugh perception task (Riem et al., 2012) was administered on a laptop using the E-Prime 2.0 software (Psychology Software Tools Inc., 2012). The task started with a baseline condition during which mothers were instructed to relax and look at three landscape photographs for 2 min in total. Skin conductance level was measured during the baseline condition, which was followed by a baseline measurement of positive affect. Subsequently, mothers listened to an infant laugh sound with a duration of 2 min in three different conditions. The infant laugh sound from Groh and Roisman (2009) was used.

Mothers were exposed three times to the laugh sound in a control, suppression, and enhancement condition. To rule out effects of different laugh sounds, we used the same excerpt throughout the study, as done in previous studies examining the effects of infant stimuli (Riem & Karreman, 2019; Riem et al., 2012). The order of conditions was randomized to diminish the potential effect of repeated exposure to the same stimulus on mothers' responses. In the control condition, mothers received no instructions regarding emotion regulation. The instruction "*You will hear an infant laughing sound. Listen to it.*" was presented on the screen. The specific suppression instructions were based on a taxonomy of emotion regulation processes linked to specific strategy instructions (see the meta-analysis of Webb et al., 2012) and have been used in previous research (Karreman et al., 2017; Riem & Karreman, 2019). According to the taxonomy, suppression of the experience of emotion could be accomplished by "instructing participants to control or not allow themselves to experience the focal emotion" (Webb et al., 2012, p. 778). Therefore, in the suppression condition, the following instruction was presented on the screen: "*You will hear an infant laughing sound. Listen to it in a matter-of-fact manner. Do not pay attention to your feelings or anything raised by the sound.*" In the enhancement condition, the following instruction was presented on the screen: "*You will hear an infant laughing sound. Listen to it and give in to the sound. Try to feel everything raised by the sound.*" This instruction was used in a previous study that showed that enhancement successfully increased the intensity of the emotion experience when listening to an auditory fragment (Karreman et al., 2017).

After each laugh sound presentation, mothers' positive affect was measured. In addition, mothers rated their positive perception of the laugh sound and their intended caregiving response. Facial expressions during the laugh sounds were recorded by the webcam.

Positive Affect

Current mood was measured with the Positive Affect Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988). We used the positive affect scale for the current study, including 10 items (e.g., interested, alert, enthusiastic). Each item was rated on a 5-point Likert scale (1 = *not at all* to 5 = *a lot*). Mean positive affect scores were calculated at baseline and for each experimental condition by averaging the ratings of positive affect assessed within each session. Cronbach's alphas ranged between .90 and .91 for the baseline measurement and the three scores for each experimental condition.

Positive Laugh Perception

Mothers were asked to indicate on a 5-point Likert scale how much affection, aversion, and warmth they felt while listening to the laugh sound. Based on a previous study on the perception of infant signals (Out, Pieper, Bakermans-Kranenburg, Zeskind, & van IJzendoorn, 2010), principal component analyses were performed for the three conditions, confirming one component for positive laugh perception (52.4% to 65.8% explained variance, factor loadings between |.42| and .90). A composite positive perception score was calculated for each condition by averaging the scores for affection, aversion (reversed), and warmth. Higher scores reflect a more positive perception of the laugh sound.

Intended Caregiving Responses

Mothers were asked to rate on a 5-point Likert scale the likelihood of using the following behaviors: pickup, cuddle, play, wait and see, firm handling, and focus on something else than on the laughing baby. Based on Out et al. (2010), principal component analysis was used to create two scores for intended caregiving responses. Principal component analyses with oblique rotation, including the six intended caregiving responses, were conducted for each condition. The analyses revealed one component for sensitive caregiving response (factor loadings between .62 and .90) and a second component for insensitive caregiving response (factor loadings between .47 and .83) (56.3% to 64.8% explained variance). The scores were calculated for each condition by averaging the ratings for pickup, cuddle, and play (sensitive caregiving response) and by averaging the ratings for wait and see, firm handling, and focus on something else (insensitive caregiving response). Correlations between sensitive and insensitive caregiving responses were $r = -.08$, $p = .42$, in the control condition, $r = -.35$, $p < .001$, in the suppression condition, and $r = -.14$, $p = .16$, in the enhancement condition.

Skin Conductance Level

Skin conductance level was assessed with the VU University Ambulatory Monitoring System (VU-AMS, http://www.vu-ams.nl/vu-ams/) during the baseline condition and the three laugh sound presentations. Markers indicating the start of each condition (baseline, control, suppression, enhancement) were recorded. The data were labeled according to these markers, and mean skin conductance level was calculated for each condition. Baseline skin conductance level was subtracted from skin conductance level during the control, suppression, and enhancement condition in order to calculate reactivity measures.

Facial Expressions

Mothers' emotional facial expressions during the baseline condition and three laugh sound presentations were recorded and analyzed afterward using Noldus's FaceReader 7 of the Behavioral Physiology lab (GO-LAB, Tilburg University). This software was trained using the Facial Action Coding System (Ekman, Friesen, & Hager, 2002). FaceReader uses a three-step approach (https://www.noldus.com/facereader/facial-expression-analysis). First, the face is detected. Second, the face is modeled in 3D by describing over 500 key points in the face and the facial texture of the face. To achieve a higher classification accuracy, the results of face modeling are combined with the results of the Deep Face algorithm, which is based on Deep Learning. In the case of unsuccessful face modeling, for example, when a mother covers her mouth with her hand, the Deep Face algorithm takes over. Third, the facial expressions are classified. High accuracy and convergent validity with FACS ratings have been reported (Lewinski, den Uyl, & Butler, 2014). Happy and sad facial expressions were analyzed during the 2-min episodes using intervals of approximately .033 s, resulting in 3597 scores for the two emotion expression scores for each of the four conditions (baseline and three experimental conditions). Happy and sad facial expression scores range from 0, representing the absence of the emotion, to 1, representing full intensity of the emotion. The missing data rate was 7.8%, primarily due to blurred frames that resulted from movement. We averaged across all non-missing data intervals for each individual in producing a mean sad and a mean happy facial expression score for each of the four conditions (baseline and three experimental conditions). Mean emotion expression scores have been used in previous studies using the FaceReader (Garcia-Burgos & Zamora, 2013; Riem & Karreman, 2019).

Plan of Analyses

Data were inspected for missingness, outliers, and distributions. There were missing data due to technical problems: E-prime data (positive affect, positive perception, and intended caregiving responses) of two participants were missing, complete skin conductance level data of eight participants were missing, and complete facial expression scores of two participants were missing. One participant lost her attention and started talking and laughing during the final laugh episode. Therefore, the scores of this final episode were coded as missing. Outliers were detected by inspecting boxplots and standardized values. Because the outliers could represent true scores, cases were retained, but scores were replaced by the most extreme value of the variable in the dataset after excluding the outliers (skin conductance level: control $n = 2$, suppression $n = 2$, enhancement $n = 3$; happy facial expressions: baseline $n = 4$, suppression $n = 3$). Analyses were repeated, including outliers, which yielded the same results (not reported).

Linear mixed models (LMMs) were tested in SPSS 24 to examine the effects of emotion regulation strategies on mothers' self-reported, physiological, and facial expressive responses. LMMs accommodate cases with missing data, which is an advantage over repeated-measures ANOVA (Blackwell, Mendes de Leon, & Miller, 2006; West, 2009). Covariance pattern models were tested. The accurateness of the fixed-effect parameter estimates and appropriateness of the statistical significance tests depend on the covariance structure of the tested models (West, Welch, & Galecki, 2007). Model fit of two covariance structures (unstructured, compound symmetry) was initially tested. Analysis of the Bayesian Information Criterion indicated the use of the covariance structure of compound symmetry as the best fitting structure in most models. Therefore, we chose the parsimonious covariance structure of compound symmetry to test our models, which assumes equal covariances for all combinations of repeated measures as well as equal variances. Parameters were estimated using the maximum likelihood (ML) method.

Separate LMMs were tested for each outcome variable (positive affect, positive perception of laughing, intended sensitive and insensitive caregiving responses, skin conductance level reactivity, happy and sad facial expressions during the laugh sounds). The models included a fixed intercept. Condition (control, suppression, enhancement) was entered as a fixed factor. To interpret the main effects of condition, post-hoc pairwise comparisons based on the estimated marginal means were used. A Bonferroni correction was applied to adjust for multiple comparisons (reported p-values are adjusted values). Order of conditions was initially tested as a fixed factor but was not found to be a significant predictor in any LMM and was therefore not included in the final models. Furthermore, inclusion of the baseline measure as covariate, entered as a fixed factor, in the analyses examining positive affect and facial expressions did not change the results (not reported).

RESULTS

Preliminary Analyses

Table 1 shows the descriptive statistics of the study variables at baseline and/or for each experimental condition. The correlations among the dependent

Table 1. Descriptive statistics of the study variables by study session.

Variable	Session	*M*	*SD*	Min – Max
Positive affect	Baseline	2.84	0.88	1.00–4.60
	Control	3.39	0.83	1.00–5.00
	Suppression	3.22	0.85	1.10–5.00
	Enhancement	3.58	0.86	1.00–5.00
Positive perception	Control	4.60	0.50	2.67–5.00
	Suppression	4.42	0.69	2.00–5.00
	Enhancement	4.73	0.44	3.67–5.00
Intended sensitive caregiving	Control	3.88	0.95	1.00–5.00
	Suppression	3.75	1.04	1.00–5.00
	Enhancement	4.09	0.85	1.67–5.00
Intended insensitive caregiving	Control	1.66	0.67	1.00–4.00
	Suppression	1.80	0.80	1.00–4.00
	Enhancement	1.61	0.68	1.00–5.00
Skin conductance level	Baseline	6.09	2.62	1.79–13.41
	Control[1]	.06	0.45	−0.81–1.17
	Suppression[1]	.02	0.58	−1.96–1.35
	Enhancement[1]	.05	0.52	−1.57–1.81
Happy facial expressions	Baseline	.07	0.10	.00 – .38
	Control	.18	0.18	.00 – .80
	Suppression	.14	0.16	.00 – .55
	Enhancement	.22	0.22	.00 – .85
Sad facial expressions	Baseline	.18	0.13	.01 – .57
	Control	.19	0.13	.01 – .54
	Suppression	.18	0.13	.01 – .63
	Enhancement	.16	0.12	.01 – .59

Note.[1]Scores represent reactivity measures, calculated by subtracting baseline skin conductance level from skin conductance level during the experimental condition.

variables in the three experimental conditions are presented in Table 2. We performed paired-samples t-tests for positive affect, skin conductance level, and facial expressions to compare baseline scores with scores for each experimental condition. Positive affect during infant laughing was higher compared to baseline in each experimental condition (control $t(96) = 6.14$, $p < .001$, suppression $t(97) = 4.55$, $p < .001$, enhancement $t(97) = 8.65$, $p < .001$). Skin conductance level scores during infant laughing did not differ from baseline for each experimental condition (control $t(87) = .14$, $p = .89$, suppression $t(90) = .22$, $p = .82$, enhancement $t(91) = .34$, $p = .74$). Furthermore, happy facial expressivity during infant laughing was higher than baseline in each experimental condition (control $t(88) = 5.84$, $p < .001$, suppression $t(89) = 3.97$, $p < .001$, enhancement $t(89) = 6.85$, $p < .001$), and sad facial expressivity during infant laughing was lower than baseline in the enhancement condition only (control $t(88) = .13$, $p = .90$, suppression $t(89) = -.36$, $p = .72$, enhancement $t(89) = -2.07$, $p = .04$).

Effects of Emotion Regulation Strategies

Table 3 presents the parameter estimates of the tested LMMs.

Table 2. Correlations among the dependent variables in the three experimental conditions.

	Control condition						Suppression condition						Enhancement condition					
Dependent variable	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
1. Positive affect	–						–						–					
2. Positive perception	.52***	–					.55***	–					.43***	–				
3. Sens. caregiving	.34**	.44***	–				.39***	.46***	–				.20*	.36***	–			
4. Insens. caregiving	.07	−.18	−.08	–			−.11	−.37***	−.35***	–			.00	−.24*	−.14	–		
5. SCL	.02	−.05	−.15	−.12	–		−.04	−.20	−.12	.08	–		.01	.09	−.13	−.10	–	
6. Happy expressions	.09	.11	−.07	−.10	.21	–	.17	.20	.07	.04	−.09	–	.16	.15	−.07	−.12	.07	–
7. Sad expressions	−.03	.07	.11	−.12	−.19	−.34**	−.19	−.04	−.08	.09	−.19	−.35**	−.11	.00	.03	−.14	−.20	−.34**

Note. SCL = Skin conductance level; Sens. caregiving = Intended sensitive caregiving; Insens. caregiving = Intended insensitive caregiving; Happy expressions = Happy facial expressions; Sad expressions = Sad facial expressions.
$^*p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 3. Parameter estimates of LMMs testing effects of emotion regulation strategies

Dependent variable	Parameter	Estimate	SE	*p*	95% CI
Positive affect	Intercept	3.38	.09	<.001	[3.21, 3.54]
	Suppression	−.15	.07	.03	[−.30, −.01]
	Enhancement	.21	.07	.01	[.06, .35]
Positive perception	Intercept	4.60	.06	<.001	[4.49, 4.71]
	Suppression	−.18	.06	.002	[−.29, −.07]
	Enhancement	.14	.06	.02	[.03, .25]
Intended sensitive caregiving	Intercept	3.87	.10	<.001	[3.68, 4.06]
	Suppression	−.12	.07	.10	[−.27, .02]
	Enhancement	.22	.07	.004	[.07, .36]
Intended insensitive caregiving	Intercept	1.66	.07	<.001	[1.52, 1.80]
	Suppression	.14	.07	.03	[.01, .27]
	Enhancement	−.06	.07	.39	[−.19, .07]
Skin conductance level	Intercept	.06	.05	.24	[−.04, .17]
	Suppression	−.05	.05	.30	[−.15, .05]
	Enhancement	−.02	.05	.72	[−.11, .08]
Happy facial expressions	Intercept	.18	.02	<.001	[.14, .22]
	Suppression	−.04	.02	.04	[−.07, .00]
	Enhancement	.04	.02	.02	[.01, .08]
Sad facial expressions	Intercept	.19	.01	<.001	[.16, .22]
	Suppression	.00	.01	.59	[−.02, .01]
	Enhancement	−.02	.01	.003	[−.04, −.01]

Note. Control condition is the reference condition; SE = standard error; CI = Confidence interval.

Positive Affect

There was a significant effect of condition, $F(2, 194.91) = 12.61$, $p < .001$, on positive affect. Pairwise comparisons indicated that mothers had higher positive affect scores in the enhancement condition compared to the control condition, $M_{difference} = .21$, 95% CI [.03, .38], $p = .015$, and suppression condition, $M_{difference} = .36$, 95% CI [.19, .53], $p < .001$. No significant difference between the suppression condition and the control condition was found, $M_{difference} = -.15$, 95% CI [−.33, .02], $p = .10$ (see Figure 1). Thus, enhancement resulted in more positive affect, whereas suppression did not result in changes in positive affect during exposure to infant laughing.

Positive Laugh Perception

The LMM with the positive laugh perception measure as dependent variable showed a significant effect of condition, $F(2, 193.98) = 15.92$, $p < .001$. Pairwise comparisons showed that mothers had higher positive perception scores in the enhancement condition compared to the control condition, $M_{difference} = .14$, 95% CI [.00, .28], $p = .049$, and suppression condition, $M_{difference} = .32$, 95% CI [.18, .46], $p < .001$. Mothers had lower positive perception scores in the suppression condition than in the control condition, $M_{difference} = -.18$, 95% CI [−.32, −.04], $p = .005$ (see Figure 1). These findings indicate a more positive perception when enhancement was employed, and a less positive perception when suppression was employed.

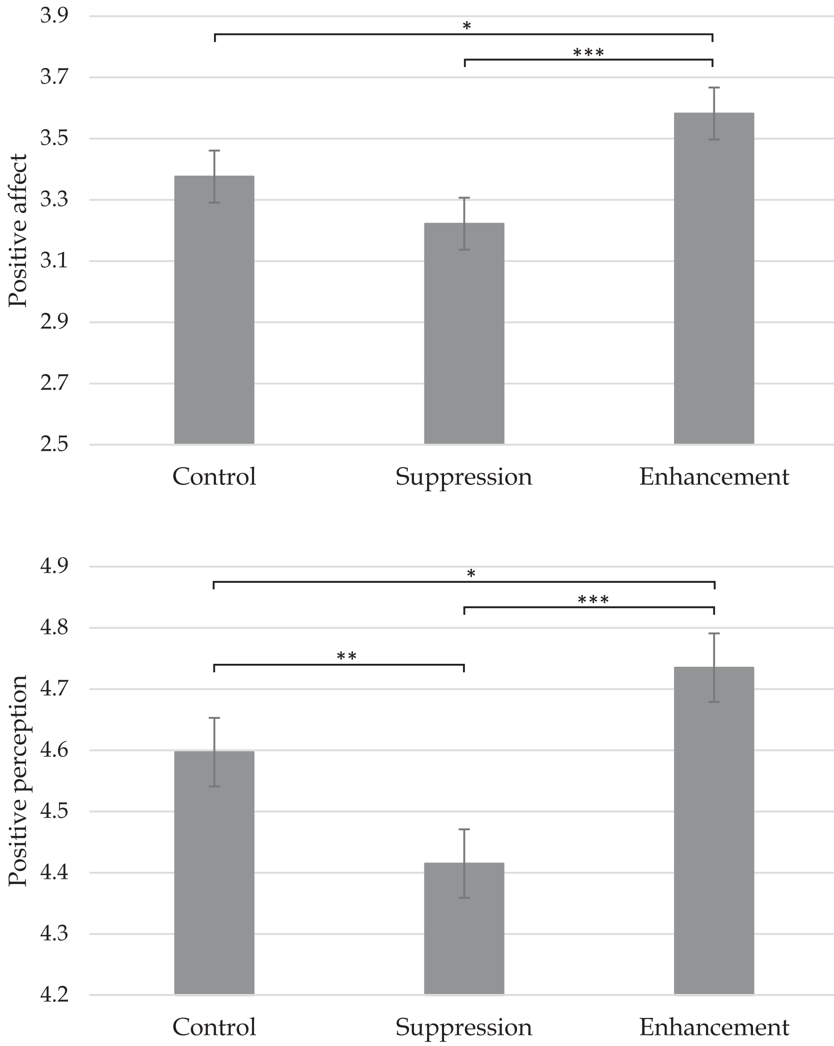

Figure 1. Mean (SE) positive affect and positive perception scores for the control, suppression, and enhancement condition. *Note*. Significant results of the pairwise comparisons, testing estimated marginal mean differences between two conditions (Bonferroni correction applied), are marked with stars.
*$p < .05$. **$p < .01$. ***$p < .001$.

Intended Caregiving Responses

There was a significant effect of condition on intended sensitive caregiving responses, $F(2, 195.18) = 10.65$, $p < .001$. Pairwise comparisons indicated that mothers were more likely to respond sensitively in the enhancement condition compared to the control condition, $M_{\text{difference}} = .22$, 95% CI [.04, .40], $p = .013$, and suppression condition, $M_{\text{difference}} = .34$, 95% CI [.16, .52], $p < .001$. No difference between the suppression condition and the control condition was found, $M_{\text{difference}} = -.12$, 95% CI [−.30, .06], $p = .31$, reflecting no effect of suppression on intended sensitive caregiving responses. We also found an effect of condition on intended insensitive caregiving responses, $F(2, 195.30) = 4.86$ $p = .009$. Mothers' intended insensitive caregiving responses were lower in the enhancement condition compared to the suppression condition, $M_{\text{difference}} = -.20$, 95% CI [−.36, −.04], $p = .008$, but not compared to the control condition, $M_{\text{difference}} = -.06$, 95% CI [−.21, .10], $p = 1.00$. There was no difference between intended insensitive caregiving responses in the suppression condition and the control condition, $M_{\text{difference}} = .14$, 95% CI [−.02, .30], $p = .097$, suggesting no effect of suppression on intended insensitive caregiving responses (see Figure 2).

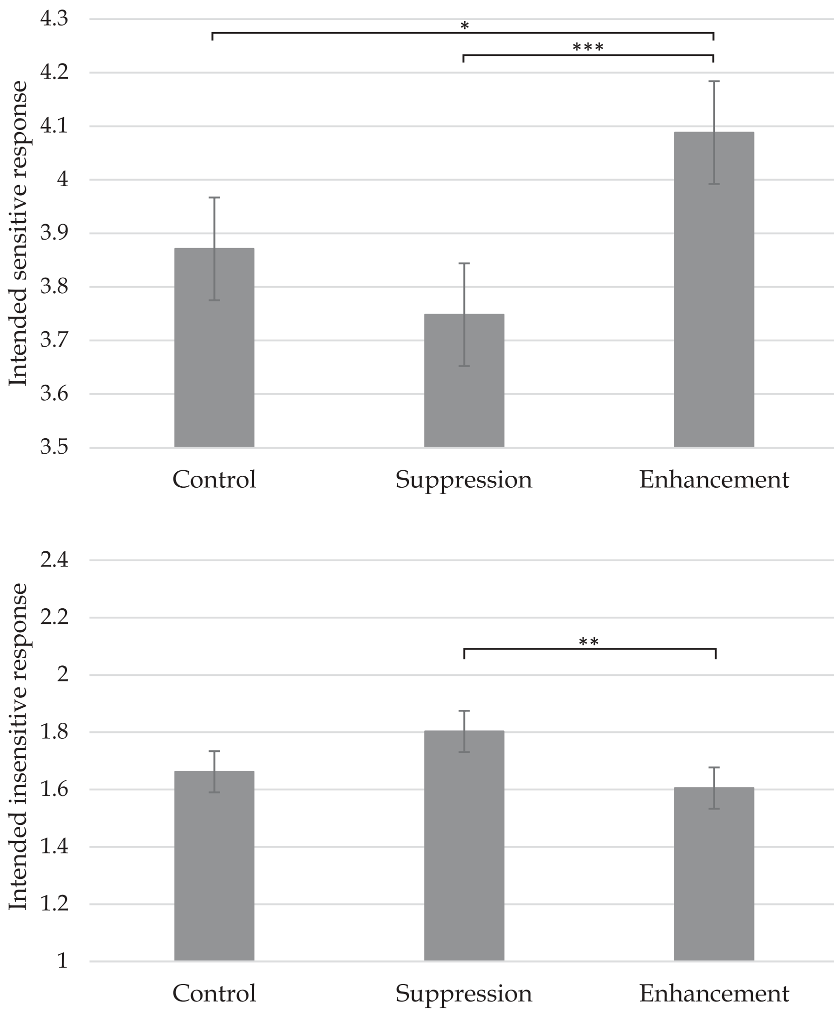

Figure 2. Mean (SE) intended sensitive and insensitive caregiving responses for the control, suppression, and enhancement condition. *Note*. Significant results of the pairwise comparisons, testing estimated marginal mean differences between two conditions (Bonferroni correction applied), are marked with stars.
*$p < .05$. **$p < .01$. ***$p < .001$.

Skin Conductance Level

No effect of condition was found on skin conductance level reactivity, $F(2, 180.05) = 0.57$, $p = .57$, indicating that suppression or enhancement strategies did not change skin conductance reactivity during exposure to infant laughing.

Facial Expressions

The LMM with happy facial expressivity as dependent variable showed an effect of condition, $F(2, 179.85) = 9.84$, $p < .001$. Pairwise comparisons showed that mothers had higher happy facial expressivity scores in the enhancement condition compared to the suppression condition, $M_{\text{difference}} = .08$, 95% CI [.04, .12], $p < .001$, but not compared to the control condition, $M_{\text{difference}} = .04$, 95% CI [.00, .09], $p = .053$. Mothers did not differ in their happy facial expressivity in the suppression condition compared to the control condition, $M_{\text{difference}} = -.04$, 95% CI [−.08, .01], $p = .13$ (see Figure 3). These findings indicate that enhancement resulted in higher happy facial expressivity during infant laughing than suppression. The LMM with sad facial expressivity as dependent variable also showed an effect of condition, $F(2, 177.88) = 5.07$, $p = .007$. Pairwise comparisons revealed that mothers had lower sad facial expressivity scores in the enhancement condition compared to the control condition, $M_{\text{difference}} = -.024$, 95% CI [−.04, .00], $p = .01$, and suppression condition, $M_{\text{difference}} = -.019$, 95% CI [−.04, .00], $p = .045$. Mothers did not differ in their sad facial expressivity in the suppression condition compared to the control condition, $M_{\text{difference}} = -.004$, 95% CI [−.02,

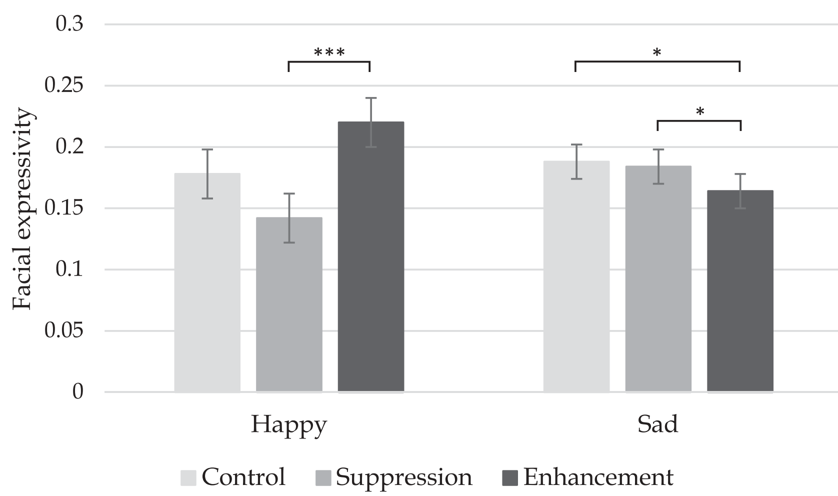

Figure 3. Mean (SE) happy and sad facial expressivity scores for the control, suppression, and enhancement condition. *Note*. Significant results of the pairwise comparisons, testing estimated marginal mean differences between two conditions (Bonferroni correction applied), are marked with stars.
*p < .05. ***p < .001.

.02], p = 1.00 (see Figure 3). Enhancement resulted in lower sad facial expressivity during infant laughing.

DISCUSSION

We examined whether instructing mothers to enhance and suppress their emotional experience can change mothers' self-reported, physiological, and facial expressive responses to infant laughing. Our results yielded partial support that mothers' positive affect, when exposed to infant laughing, can be manipulated: enhancement resulted in increased positive affect, whereas suppression, unexpectedly, did not result in changed positive affect. Furthermore, enhancement, as expected, resulted in a more positive perception of the laugh sound, more intended sensitive caregiving responses, and, although only compared to the suppression condition, fewer intended insensitive caregiving responses. Additionally, enhancement resulted in lower sad facial expressivity as well as higher happy facial expressivity compared to the suppression condition. We did not find the expected effects of enhancement on skin conductance level reactivity. Suppression resulted in a less positive perception of the laugh sound only, whereas we also expected effects on the other outcomes. Taken together, although the results should be interpreted with caution, this study showed for the first time that instructing mothers to employ enhancement, contrary to suppression, changed most self-reported and facial expressive responses to infant laughing.

Enhancement appeared to have beneficial effects on mothers' responses to infant laughing. When mothers were instructed to enhance their emotional experience, they were more able to enjoy infant laughing and more likely to respond sensitively to infant laughing, shown by their intended caregiving responses, and more objectively, by their facial expressions. By means of enhancement, mothers may listen to infant laughing more attentively, which may increase its positive effects, promoting sensitive responses that are essential to the development of mother-infant attachment (Bowlby, 1969; Sroufe & Waters, 1976). Instructing mothers to enhance the *experience* of emotions when listening to infant laughing also changed their outward *expression* of emotions, even though the latter was not the focus of the instruction in contrast to most prior studies (e.g., Bonanno et al., 2004; Gyurak et al., 2012). Enhancement of emotion experience might be employed by mothers who do not experience emotions intensely or who are not very emotionally expressive themselves. Thus, enhancement may be a promising strategy for mothers to up-regulate their emotions when hearing infant laughing, which may improve affective responses during daily playful interactions with their infant. Positive affective responsivity to infant signals is important as infants are susceptible to their mother's behavioral and facial expressive responses (Field et al., 2007).

In contrast to our expectations, we did not find enhancement and suppression to affect skin conductance level reactivity. In a previous study, we found that suppression instructions, compared to cognitive reappraisal instructions, resulted in higher skin conductance level reactivity when exposed to infant crying (Riem & Karreman, 2019). Crying might be more arousing for mothers than laughing as it is a more alarming signal in terms of attachment needs. Consistently, a previous study reported that infant smiling reduced mothers' skin conductance that was heightened after exposure to infant crying (Mizugaki, Maehara, Okanoya, & Myowa-Yamakoshi, 2015). In general, skin conductance is more responsive to negative stimuli than positive stimuli (Ohira et al., 2006). Increased skin conductance level in response to infant crying has been reported in prior studies (Emery et al., 2014; Groh & Roisman, 2009). However, exposure to infant laughing in the control condition of the current study also did not evoke a skin conductance response compared to baseline, which is in contrast with previous studies on responses to infant laughing (Emery et al., 2014; Groh & Roisman, 2009). This lack of arousal, when exposed to infant laughing, may account for the finding that there were no experimental condition effects.

The experimental manipulation of suppression was not successful in diminishing positive feelings in response to infant laughing. An explanation may be the salience of an infant laughing sound: positive feelings induced by the laughter may be difficult to suppress. However, several previous studies also reported that suppression instructions were not effective in changing positive feelings (Hofmann et al., 2007; Karreman et al., 2017). In daily life, individuals use suppression of the expression of positive emotions less often than they use other strategies (i.e., suppression of the expression of negative emotions and reappraisal of positive and negative emotions; Nezlek & Kuppens, 2008). People may also have not much experience with suppression of a positive emotional experience, making it a difficult task. Furthermore, instructing mothers to suppress their feelings may yield a similar "white bear" effect as when instructing individuals not to think about something (Wegner, Schneider, Carter, & White, 1987). Mothers may paradoxically focus on their feelings when instructed not to pay attention to their feelings. However, suppression was effective in diminishing the positive perception of the laugh sound in this study, which may be due to the instructions that were given to the mothers to suppress feelings specifically triggered by the sound.

Several limitations of this experimental study should be noted. First, data collection occurred at the mothers' homes, which is a non-standardized environment. For instance, seating conditions differed considerably among participating mothers. Moreover, in some cases, children were present, and even though experimenters looked after them to prevent mothers from being distracted, potential influences could not be precluded. However, concerning exposure to infant signals, the home situation is more ecologically valid than a standardized laboratory situation. Second, the Laugh Paradigm was preceded by a Cry Paradigm, which was administered for the purpose of another study (Riem & Karreman, 2019). The baseline condition of the Laugh Paradigm was designed to achieve a neutral state in mothers. However, we cannot rule out possible order effects of listening to crying sounds. Third, we used a standard laugh sound to be able to control laugh characteristics and duration. The effects of a standard laugh sound might differ substantially from the effects of the laugh sound of a mother’s own child in a natural setting. Research has shown increased activity in reward-processing brain regions in mothers in response to viewing smiling faces of their own infant compared to viewing smiling faces of an unknown infant (Strathearn, Li, Fonagy, & Montague, 2008). Moreover, although all mothers in our sample had a child younger than 3 years of age, in mothers of a toddler-aged child, the infant laughing sound may not translate to the laughing signal of their own child, which may have affected their responding. Fourth, sensitive and insensitive caregiving responses were measured by averaging specific parental behaviors. However, as the appropriateness of a parental response to infant crying is considered to depend on the context (Hubbard & van IJzendoorn, 1991), the parental behaviors that are sensitive in response to infant laughing may also depend on contextual factors. For example, “wait and see,” one of the insensitive caregiving responses, may be a sensitive response when an infant laughs while he or she is playing alone. Fifth, because of the within-subjects design of this study, mothers may have had an idea of the research purpose of the three conditions. However, the within-subjects design excluded potential effects of participant differences between conditions that are of concern in a between-subjects design (e.g., some mothers are better able to employ enhancement or suppression, or react more strongly to infant laughing, than other mothers).

Some directions for future research could be suggested. First, future studies should examine the effects of enhancement and suppression, exposing mothers to the laugh of their own infant. It is unclear to what extent mothers’ responses to a standard laugh sound generalize to their responses when interacting with their own infant, whereas responses to their own infant’s laugh actually matter to mother-infant interactions. Second, future research should examine effects of individual-difference variables on mothers’ responses to infant laughing to clarify which mothers are most at risk for less optimal responding to infant laughter. For instance, prior studies showed effects of mothers’ attachment styles, parenting experiences, and depressed mood on their responses to infant cues (Bernard, Nissim, Vaccaro, Harris, & Lindhiem, 2018; Field et al., 2007; Parsons, Young, Stein, & Kringelbach, 2017; Strathearn, Fonagy, Amico, & Montague, 2009). Responses to emotional cues may depend on the habitual use of emotion regulation strategies (Wolgast, Lundh, & Viborg, 2011). Third, there is a need to understand the mechanisms between emotional responses to infant laughing and caregiving behavior, which should, therefore, be the focus of further research. Last, future studies should examine whether enhancement also affects the perception of and reactivity to visual infant cues, such as infant smiling, because the present study focused on the auditory aspect of infant laughter.

IMPLICATIONS FOR PRACTICE AND THEORY

When engaging in enhancement strategies, mothers were likely more able to enjoy infant laughing and to respond more sensitively to infant laughing, shown by their intended caregiving responses, and more objectively, their facial expressions. Mothers' increased positive emotion experience may influence their motivations to approach the laughing child sensitively (Dix, 1991). This knowledge could be used to develop hands-on intervention techniques for mothers to engage in more joyful and contingent affective interactions with their infant. For example, interventions may be directed at increasing mothers' observations of their laughing infant to become more aware of the infant's laughing signal. Future research should, therefore, further examine the potential of enhancement of emotion experience instructions in improving mothers' experienced and expressed responses to infant laughing.

ADDRESSES AND AFFILIATIONS

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ARTICLE INFORMATION

Conflict of Interest Disclosures

Each author signed a form for disclosure of potential conflicts of interest. No authors reported any financial or other conflicts of interest in relation to the work described.

Ethical Principles

The authors affirm having followed professional, ethical guidelines in preparing this work. These guidelines include obtaining informed consent from human participants, maintaining ethical treatment and respect for the rights of human or animal participants, and ensuring the privacy of participants and their data, such as ensuring that individual participants cannot be identified in reported results or from publicly available original or archival data.

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